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GRAVITY-FLOW SAMPLER FOR WATERSHED RUNOFF

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INTRODUCTION

Interest in water quality has increased the need for adequate devices to sample runoff from small watersheds. Manual collection of runoff samples from areas less than 10 acres is unsatisfactory because of the short hydrograph time to peak runoff and the rapid changes in the concentration of pollutants; much of the total volume of water has passed the gaging station before a man can arrive at the site. Previous samplers suitable for small watersheds have been too complex for easy installation and maintenance or prohibitive in cost. The sampler described here is simple to install, is low in cost, and requires minimum maintenance.

The device consists of gravity-flow, stage-actuated samplers to collect the rising stage and battery-powered valves for collecting

falling-stage samples. While it was designed primarily for use with H-flumes, it can be adapted to most flow-measuring devices if gravity flow can be attained. The general operation of the sampler is illustrated in figure 1, which shows the model used to develop the field sampler.

CONSTRUCTION OF SAMPLER

The construction of the gravity-flow sampler is illustrated in figures 2-5. The parts are listed in the table. The device includes a series of modified single-stage samplers for collecting the rising-stage flow. For each sampler, a single 1/4-inch copper tube is inserted through the wall of the flume at the desired gage height to be sampled and connected with plastic tubing to a collection jar (fig. 2).

A 1/4-inch copper tube is inserted through the wall of the flume at some point below the water level of the desired stage to be sampled to collect falling-stage samples. A battery-operated solenoid valve is installed in the line and connected to the collection jar. A series of micro-switches is installed below the recorder on the weight side of

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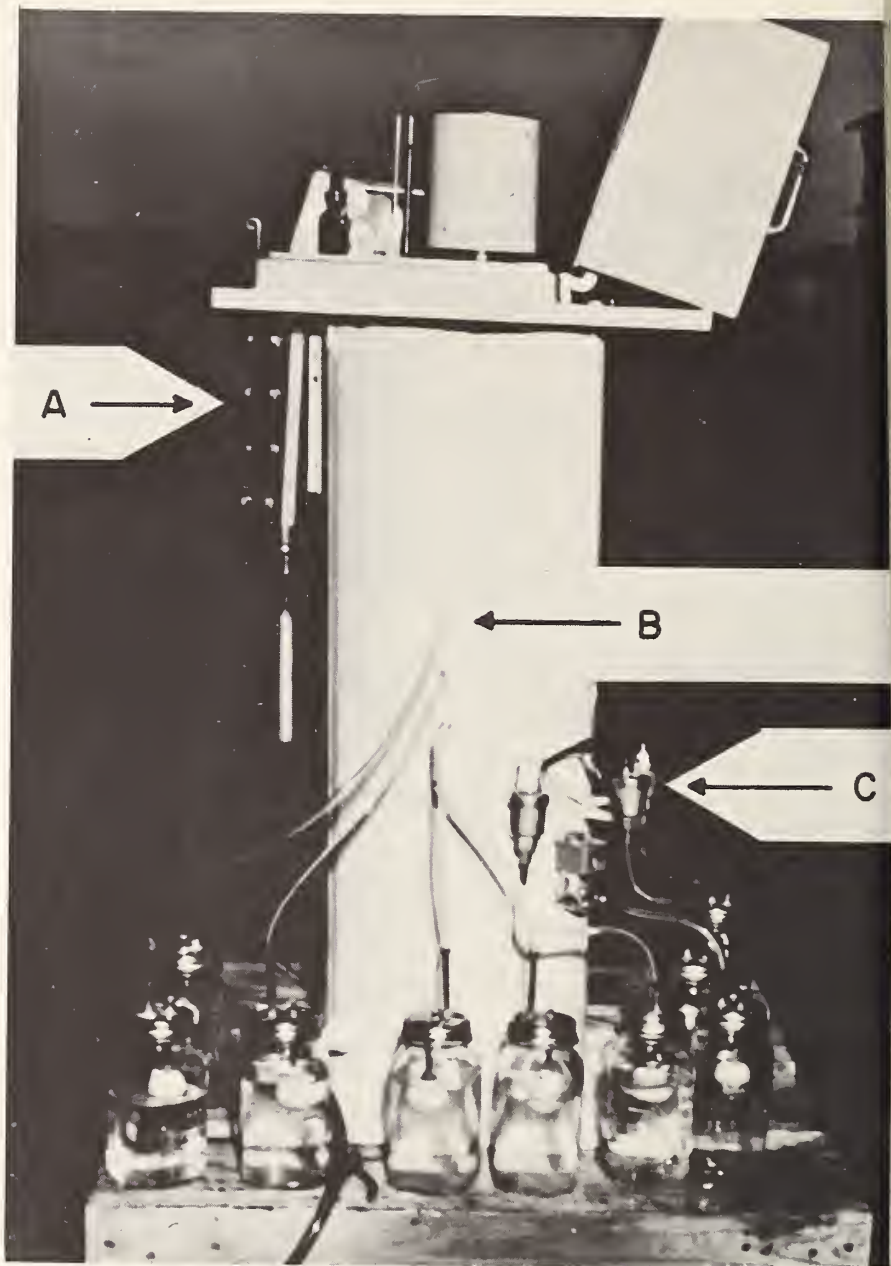


Figure 1. — Model sampler used to develop field sampler. Modified gravity-flow, single-stage samplers obtain samples of the rising-stage flow; the water outlets for these samples are shown at B. Battery-operated solenoid valves, shown at C, sample the falling stage. A 12-volt dry-cell battery is the power source. Microswitches (A) installed on a water-stage recorder tape energize the solenoid valves. The samples are collected in ordinary jars in which table-tennis balls serve as air-lock valves.

the recorder tape to activate the solenoid valves (fig. 3). These switches are mounted to allow a trigger, fastened to the recorder tape, to bypass the switches on the rising stage, but to activate them on the falling stage (fig. 4).

A tape guide is used to stabilize the recorder tape to insure actuation of the switches. The collection jar is a common 1-quart fruit jar (fig. 5). Two short pieces of 1/4-inch copper tubing are soldered into the lid.

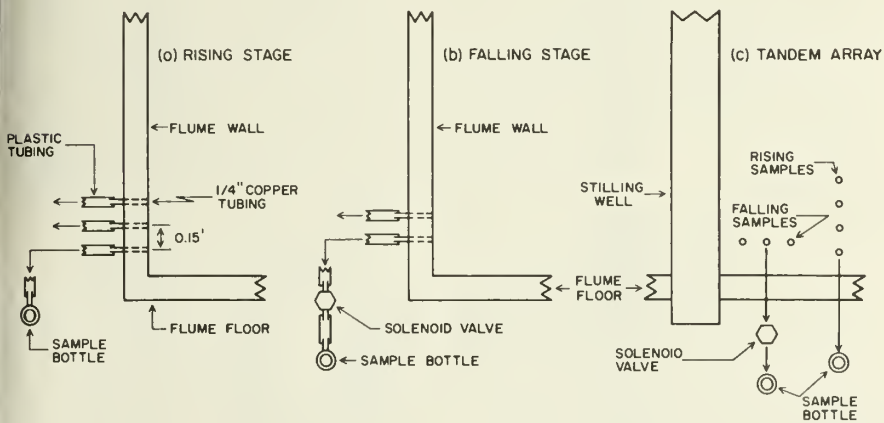


Figure 2.— Installation of gravity-flow sampler in flume wall.

Parts for Gravity-Flow Sampler

Description	Amount
FOR ONE RISING-STAGE SAMPLER	
Copper tubing, 1/4-in.-diam.	1 1/2 ft.
Plastic tubing	2 ft. ¹
Fruit jar, 1-qt., with lid	1
Table-tennis ball ²	1
Rubber contact valve ²	1
Funnel ²	1
FOR ONE FALLING-STAGE SAMPLER	
Microswitch	1
Battery-operated solenoid valve	1
Insulated wire, No. 16	3 ft. ¹
Shim stock, No. 0.003, 3/16 in. by 1 1/2 in.	1 section

¹ Length depends on location.
² May be replaced by a commercially made air-lock valve.

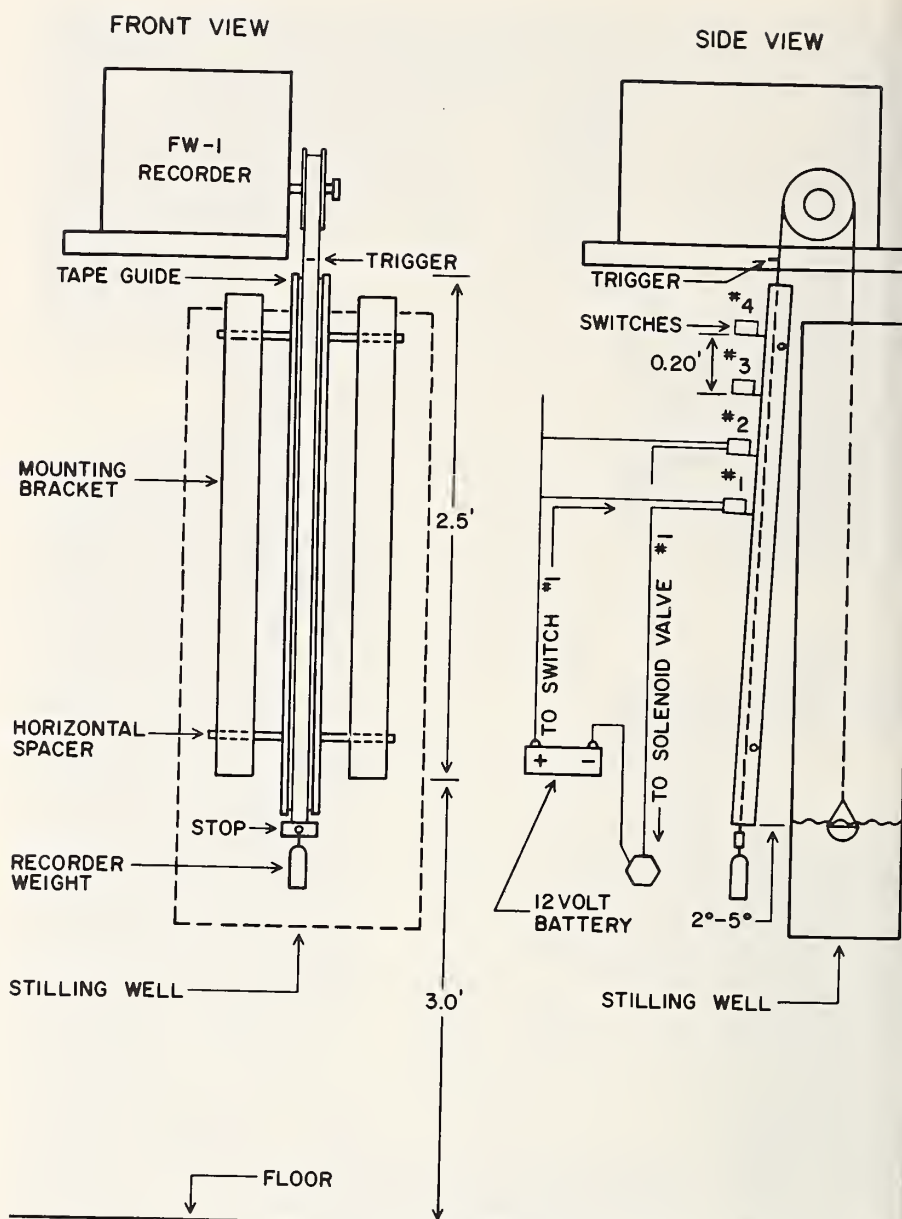


Figure 3. — Installation of microswitches and mounting brackets.

One is used for the water intake and the other for an air exhaust. An airlock valve is attached to the air exhaust line inside the

jar. The valve is made with a table-tennis ball and a soft rubber contact seal. The air-lock valve is then encased in a hous-

ing to guide the table-tennis ball to the seal. In figure 5 the housing consists of an inverted funnel slipped over the end of the air exhaust line. This valve arrangement will allow the jar to fill only to the point where the air exhaust line is closed, thus eliminating any danger of dilution by continuous circulation of water. A commercially made air-lock valve may be purchased. However, a savings of approximately \$5 per valve may be realized by constructing the valve as described.

TEST INSTALLATION

The sampler was installed in a 3-foot H-flume on a 3-acre native-grass watershed located at the Blackland Conservation Research Center, Riesel, Tex., where the flow depth rarely exceeds 2

feet. Because rising-stage samples at 0.15-foot intervals were desired, 14 gravity-flow samplers were needed. Ten solenoid valve installations were required, as falling stage samples were needed at 0.20-foot intervals. The installation cost was approximately \$1.50 for each rising-stage sampler and approximately \$11 for each falling-stage sampler. The cost of installing the sampler will of course vary with the number of component samplers required for a site.

CONCLUSIONS

The gage heights at which samples are taken are determined by the position of the inlet orifices for the rising-stage samplers and by the position of the microswitches for the falling-stage samples. The time that each sam-

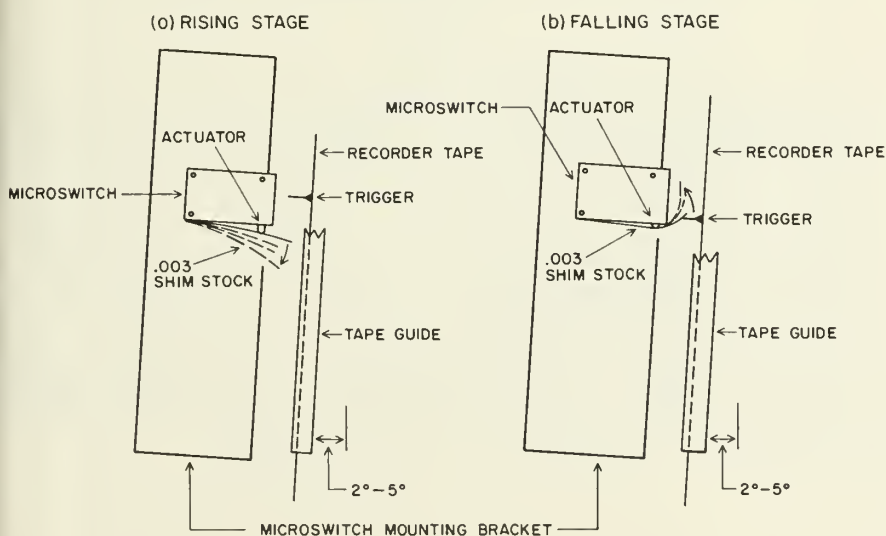


Figure 4. — Microswitch bypass functions.



Figure 5. — Sample container with air-lock valve.

ple was taken can be determined from the time-stage record on the recorder chart. Figure 6 illustrates the sampling schedule that would result from using the gravity-flow sampler during three runoff events. Storms with single peaks (fig. 6a) can be sampled adequately during all portions of the storm. Storms with secondary rises cannot be sampled during portions of the second rise

(figs. 6b and 6c). However, multi-peaked storms can be sampled completely if sufficient time lapses between the two peaks to allow resetting of the sampler.

An adaption is under study to integrate a time-dependent feature into the sampler so that samples of sustained flows can be obtained. Consequently, samples could be obtained automatically for several days.

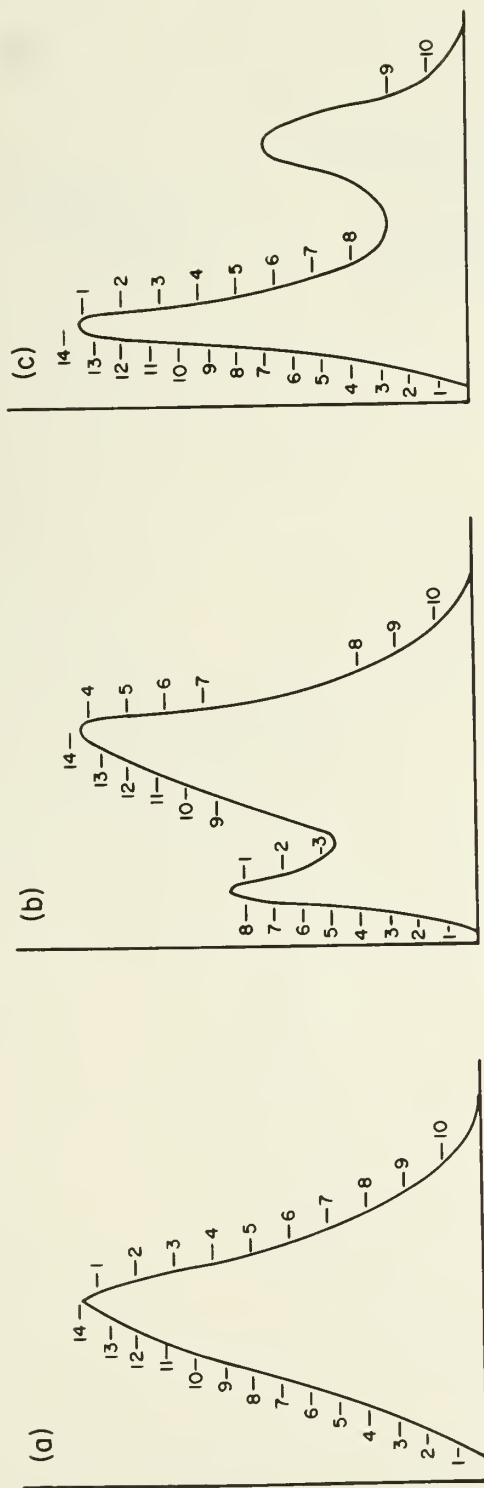


Figure 6.—Example storm hydrographs: (a) single peak, (b) multipike, and (c) multipike.

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